Space Weather Technical Forecast

Issued on Tuesday, 11 October 2022 at 01:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares. Active electron Fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the past 24 hours, with an M2.4 flare peaking at 10/1628 UTC from AR3112. There was one other M flare and several C flares. There are five numbered sunspot groups on the disc. AR3112 remains the largest and most complex region on the disk, though has lost its delta configuration due to the splitting on the intermediate spot region. To its north, AR3116 continued to see some fading to its trailing portion. In the east AR3118 saw little change continuing to display a small delta spot. AR3119 has just crossed into the western hemisphere but hasn't produced any significant flares. AR3120 remains a small uni-polar spot.
Around 09/2300 UTC a filament eruption was seen from the southeast quadrant, this has been analysed as missing to the south and behind Earth. Finally, during the early hours a dimming was detected in AIA211 in the central southwestern quadrant, possibly related to a filament lift off. Imagery has been analysed and does not support an Earth-directed component.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1 has declined from elevated levels to slightly elevated values around 470 km/s as Earth exits a coronal hole high speed stream. The phi angle was mostly positive (away from the Sun). The solar wind density started the period slightly above average before easing back to average values. The IMF was within its typical weak background range, with a peak near 6nT. The north-south component was small-scale but mainly anti-aligned with Earth's field, with peaks of -5 and +4nT observed, with a more neutral variation at times. Geomagnetic activity was Quiet to Unsettled.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, has been at Background levels.
High energy electron flux (greater than 2MeV) has been at Moderate to High levels, peaking at 3590 pfu at 10/16725 UTC. The associated 24-hour fluence has been above the Active (1e8 integrated pfu) threshold throughout. The 10/2359 UTC observation was 1.55e8 integrated pfu.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low to Moderate initially. This may reduce through the period as current sunspots look to simplify slightly, but with Moderate still possible particularly as one or more new active regions are likely to rotate over the eastern limb onto the visible disk. . None of the more noteworthy groups on the disc are expected to leave the western limb in the next four days, though 3112 will be close by the end of day 4 (14th Oct).

Solar Wind / Geomagnetic Activity: There are no major Earth-directed CMEs in the forecast, however the 07/0730 UTC filament eruption CME may pass close to the Earth late on day 1 or early day 2 (11th or 12th), giving some very slight peripheral influences.
Otherwise, ongoing fast winds, most probably from CH29/+ and perhaps CH31/+, are likely to continue to ease through day 1 (11th), likely approaching background by day 2 (12th October). Some enhancement is possible at times due to possible glancing CME effects.
Largely Quiet to Unsettled but with a risk of Active intervals late on day 1 or early on day 2 (11th or 12th) due to possible glancing CME effects and a slight chance of an isolated G1 Minor Storm interval for the same region.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at Background, but with a daily Slight Chance of rising in response to any large flares, primarily from AR3112 or AR3116 in the northwest disc.

The high energy electron flux (greater than 2 MeV) is likely to persist at mainly Moderate to High levels. The associated electron fluence is forecast to persist at Active levels, but with confidence declining later in the period, especially if Earth does encounter glancing CME effects.

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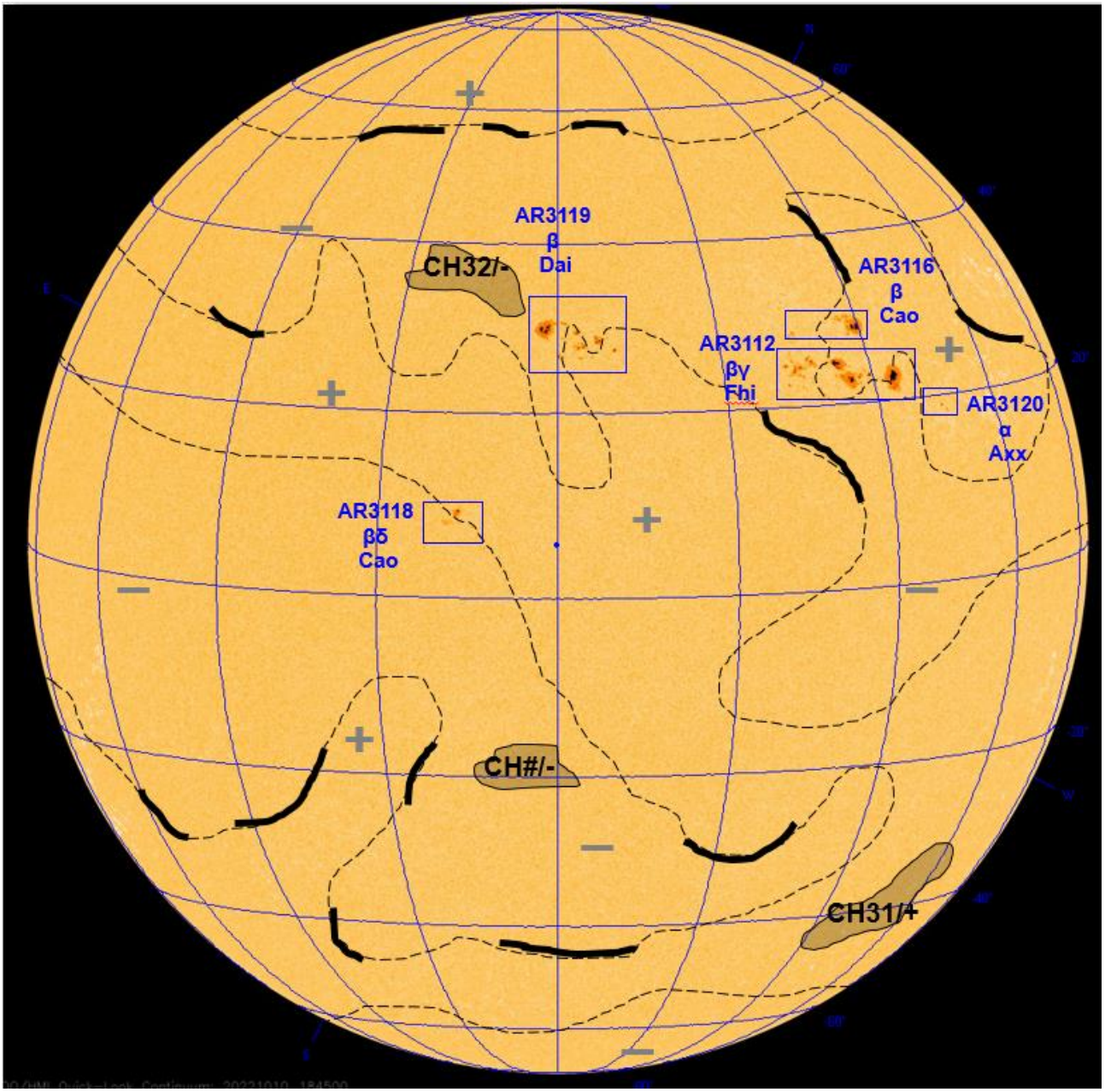
Figure 1. Solar Analysis Valid 10/1900 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no major Earth-directed CMEs in the forecast, however the 07/0730 UTC filament eruption CME may pass close to the Earth overnight UTC 11 into 12 October, giving some very slight peripheral influences. The 09/2300 UTC filament eruption from the southeast quadrant has been analysed as having the potential for an Earth directed component, with provisional assessment giving the risk of a glancing hit early on the 14th.
Otherwise, ongoing waning fast winds, most probably from CH29/+ and perhaps CH31/+, are likely to continue to gradually ease through day 1 (11th), likely approaching background day 2 (12th October). Some further enhancement is possible late on day 1 or early on day 2 (11th or 12th) due to possible glancing CME effects.
Largely Quiet to Unsettled, but with a risk of Active intervals and a slight chance of G1 Minor geomagnetic storms late on day 1 or early on day 2 (11th or 12th Oct) in association with possible glancing CME impacts.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
07/1715UTC	Partial	Filament eruption	NW quadrant	370km/s	11/2359UTC +/- 8 hrs	Weak, low confidence, glancing blow.

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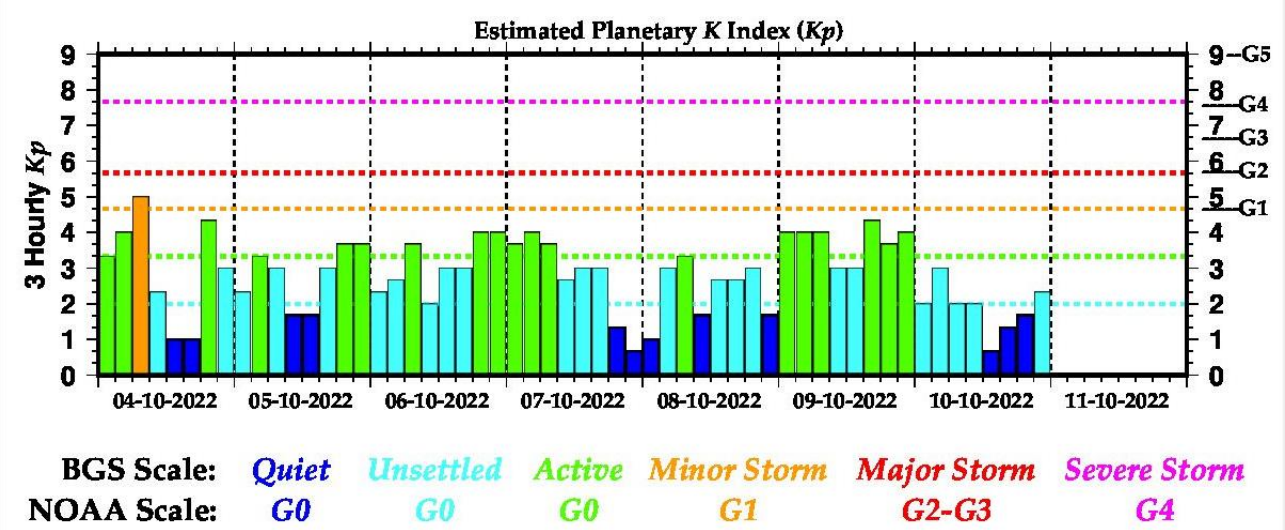
Figure 2: BGS Kp



Radio Blackouts - X-Ray Flares:

There are now five sunspot regions on the disc, and these should remain on the Earth-facing side regardless of the fates of these spots in terms of development or decay over the four days.
Far-side soundings suggest that there may be a succession of large regions due over the eastern solar horizon through the course of the coming 4 days, with this implying a possible increase in the risk of flares, although this will be confirmed as and when they present over the eastern limb for analysis.
There is therefore a flat trend in flare risk at present, with AR3112 dominating, although the risk has been revised downwards significantly from raw values arising from historical precedents. Reasons for doing so include AR3112's penchant for small long-period flares; its age; its lack of shear for mostly lying at one (extended) solar latitude. Also, it is currently without any delta spots. AR3118 has also shown development of a small delta spot and will need monitoring.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES16 X-Ray flares

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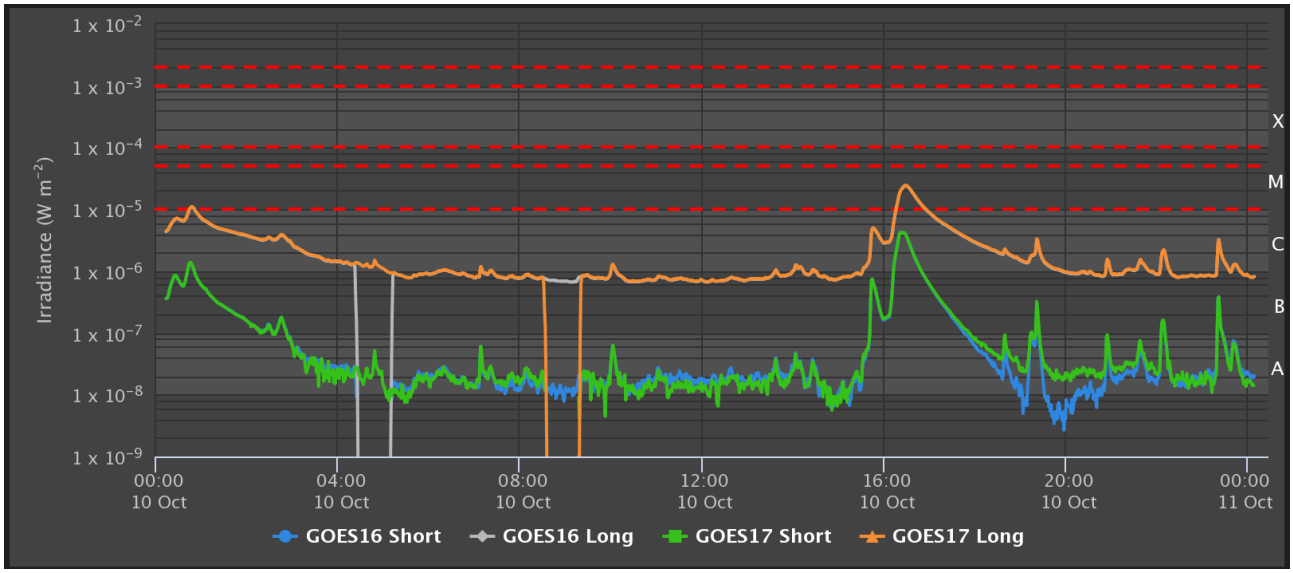

Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10MeV) as observed by GOES16 is currently at Background levels.
While there has yet to be any notable flaring from AR3112 and AR3116 in particular, their westward advance and nominal complexity mean that there is a residual slightly rising chance of S1, although the rise is too slight to represent in the probability tables. Any arriving eastern horizon regions are thought unlikely to contribute for some time yet to this risk.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):
The high energy (greater than 2MeV) electron flux as observed by GOES16 is currently High and is likely to range between Moderate and High through the coming days. Glancing CME effects are possible late on day 1 or early on day 2, which may give a reduction in flux however. Fluence is currently above Active (1e8 integrated pfu). Given that the threat of significant geomagnetic activity is greatest earlier on in the four-day forecast period, the chances of the current diurnal oscillation being disturbed or re-set at lower flux levels is highest late on day 1 or during day 2. Should this not occur, fluence is likely to remain Active, although with decreasing confidence in the coming days.
Overall, Active fluence is considered likely until day 4 (14th).

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	80	60	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4:GOES16 ElectronFlux mostly high for past three day.

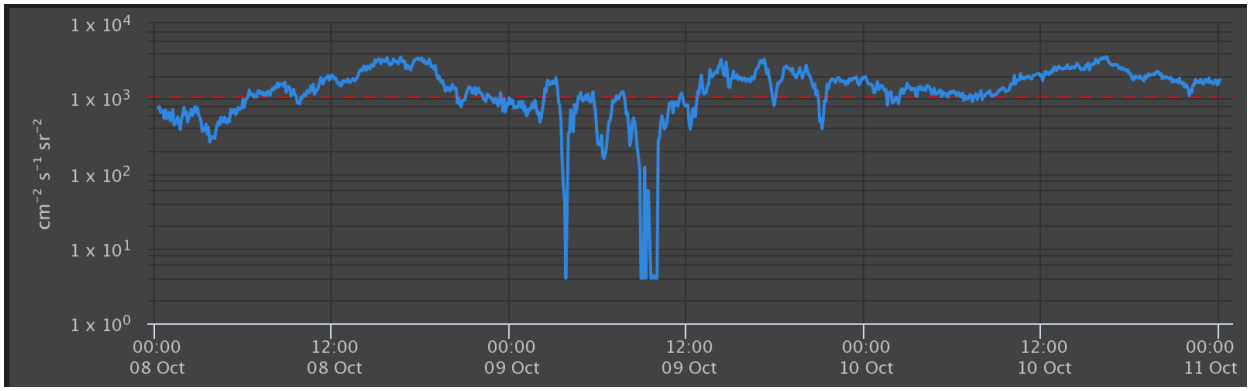
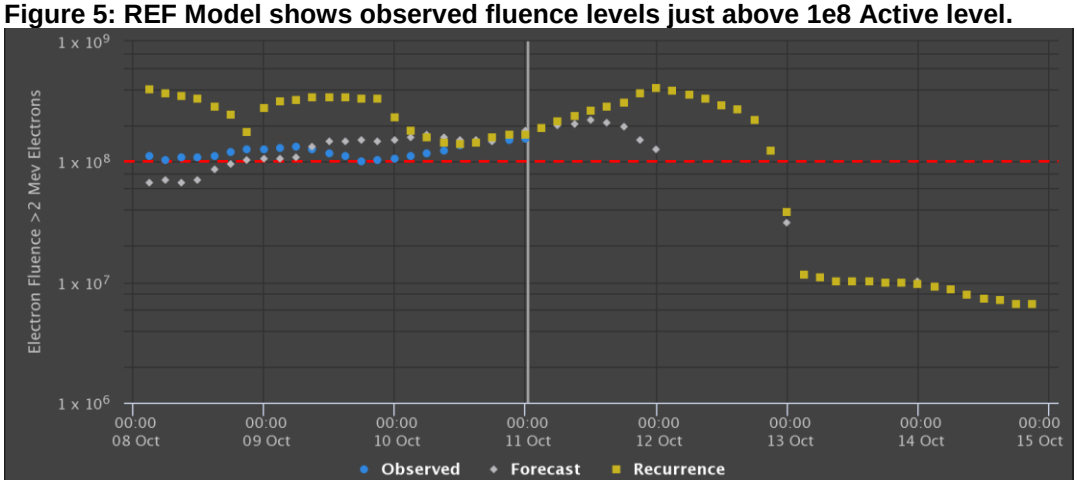


Figure 5: REF Model shows observed fluence levels just above 1e8 Active level.



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